

of SEQ. ID. NO: 2 or the complement of the nucleotide sequence of SEQ. ID. NO: 2.

53. (New) A genetically engineered host cell comprising a nucleotide sequence that encodes a polypeptide consisting of the amino acid sequence of SEQ. ID. NO: 2 or the complement of the nucleotide sequence of SEQ. ID. NO: 2 operatively associated with a regulatory sequence containing transcriptional and translational regulatory units that controls expression of the nucleotide sequence in the host cell.
54. (New) A genetically engineered host cell of claim 53 wherein the host cell is prokaryotic.
55. (New) A genetically engineered host cell of claim 53 wherein the host cell is eukaryotic.

REMARKS

Claims 1-10, 26-28, 31, 32, 35, 36, 38, 42 and 44 have been amended to more particularly point out and distinctly claim the invention. Claims 1-5 have been deleted. The amendments are supported in the specification and the original claims as filed. In particular, in Claim 6-8, the phrase "SEQ. ID. No: 1" and the phrase "SEQ. ID. No: 2" in new Claims 51-53, have support in the specification at page 12, lines 5-10 and 26-30. In Claims 27, 31 and 42, the phrase "wherein said MAPK5 ortholog is functionally similar to OsMAPK5" has support on page 10, lines 4-5. The phrase "low temperature" in Claim 36 has support on page 3, line 26. The term "Graminaceae" has support on page 15, line 23-24. None of the amendments introduces new matter.

The Examiner has objected to Description of the Drawings. Specifically, the Examiner argues that the five sequences in Figure 1A must be referred to by their sequence identifiers either within the drawing or its brief description. Applicant has included sequence identification numbers for TaWCK-1 and NtWIPK in the description of Figure 1, as SEQ. ID. NO: 9 and 10, respectively. Applicant has also submitted hereto a Supplemental Sequence Listing containing sequences for TaWCK-1 and NtWIPK. The Examiner has also objected to the abbreviations Avr and Vir. Applicant has added the phrase "Avr and Vir denote avirulent and virulent isolates of the blast fungus, respectively" on page 5 under the description of Figure 3.

The Examiner has also objected to typographical errors in the Specification on page 4, line 15 lacking the term "invention"; page 12, lines 24 and 30 containing the term "transitional"; and page 17, line 24 containing the symbol "?". Applicant hereto submits Exhibit B denoting replacement of the term "transitional" with "transcriptional"; addition of the phrase "Avr and Vir denote avirulent and virulent isolates of the blast fungus, respectively"; addition of the term "invention" between the terms "present also"; and deletion of the symbol "?" on pages 4, 5, 12 and 17, respectively, by way of addition (underline) or deletion (strikethrough). Due to pagination changes as a result of these corrections, Applicant hereto submits a replacement specification.

1. The Original Claims Particularly Point Out and Distinctly Claim the Subject Matter of the Present Invention

Claims 26, 31, 35 and 38 have been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Applicants submit that this rejection has been obviated because Claims 26, 31, 35 and 38 have been amended to avoid the

Examiner's objections. Specifically, the Examiner states the phrase "continuous cell line" in Claims 26 is indefinite. Applicant has amended Claim 26 to obviate this rejection.

The Examiner further states that the phrase "nucleic acid sequence that encodes a MAPK5 ortholog nucleic acid sequence" is confusing. Applicant has amended Claim 31 to read "comprises" rather than "encodes".

Dependent Claim 35 is objected because it depends on claims which were withdrawn. Applicant has amended Claim 35 to obviate this rejection.

The Examiner also states that the phrase "A seed produced by a transgenic plant" in Claim 38 is confusing because according to the Examiner, it is unclear whether the seed comprises the MAPK5 ortholog nucleic acid. Applicant has amended Claim 38 to by adding the phrase "wherein said seed comprises said nucleic acid encoding the MAPK5 ortholog".

2. The Claimed Invention is Enabled Under 35 U.S.C. § 112

The Examiner has objected to the specification under 35 U.S.C. § 112, first paragraph, as failing to enable one skilled in the art to make or use the invention as claimed and alleges that undue experimentation would be required to determine the conditions required to practice the claimed invention. Applicant respectfully submits that these rejections are in error and should be withdrawn for the reasons detailed below.

Undue experimentation is experimentation that would require a level of ingenuity beyond what is expected from one of ordinary skill in the field. *Fields v. To*, 170 U.S.P.Q. 276, 279 (C.C.P.A. 1971). The factors that can be considered in determining whether an amount of experimentation is undue have listed in *In re Wands*, 8 U.S.P.Q.2d 1400, 1404 (Fed. Cir. 1988). Among these factors are: the

amount of effort involved, the guidance provided by the specification, the presence of working examples, the amount of pertinent literature and the level of skill in the art. The test for undue experimentation is not merely quantitative, since a considerable amount of experimentation is permissible, if it is merely routine. Id.

While the predictability of the art can be considered in determining whether an amount of experimentation is undue, mere unpredictability of the result of the experiment is not a consideration. Indeed, the Court of Custom and Patent Appeals has specifically cautioned that the unpredictability of the result of an experiment is not a basis to conclude that the amount of experimentation is undue in *In re Angstadt*, 180 U.S.P.Q. 214, 219 (C.C.P.A. 1976).

The Examiner rejected Claims 7, 8, 9, 10, 26, 27, 31, 35, 36, 38, 42 and 44 under 35 U.S.C. § 112, first paragraph, because according to the Examiner, the specification does not reasonably provide enablement for a transgenic plant with increased stress tolerance or a method of producing the transgenic plant comprising over-expression of any nucleic acid sequence encoding any MAPK5 or MAPK5 ortholog isolated from any source. Applicant has amended independent Claims 27, 31 and 42 to include the phrases “functionally similar to OsMAPK5” and “isolated from the *Graminaceae* (“grass”) family”. However, as discussed below, Applicant submits that the Examiner is in error and the specification as filed provides distinguishing characteristics of the genus of this invention.

Applicant submits that the specification provides guidance as to how to use the present invention. First, one skilled in the art would be aware of various techniques for using a prokaryotic or eukaryotic host cell. Furthermore, based on the present invention, one skilled in the art would know to screen for MAPK5 orthologs functionally similar to OsMAPK5 wherein the MAPK5 is expressed and possesses

kinase activity. Moreover, the current invention provides guidance that OsMAPK5 activity is enhanced by cold temperature and salt treatments (Examples 8.6 and 8.11).

Applicant submits that the specification provides guidance to the characteristics of MAPK5 orthologs capable of increasing abiotic stress tolerance in plants. Specifically, the specification provides guidance that enables the skilled artisan to use the current method with little or no experimentation. In particular, Example 8.3 provides that the only OsMAPK5a possessed kinase activity suggesting the importance of the missing domain in OsMAPK5b. Further, the specification provides that the OsMAPK5 is induced by abscisic acid and wounding, (Example 8.5), induced by *M. grisea* infection (Example 8.4), over-expressed and suppressed in transgenic plants (Examples 8.7-8.8).

The Examiner also contends that undue experimentation by one skilled in the art is required to make use of expressing said polypeptide in a host cell other than bacteria or plant cell, as MAPK5 is a plant protein. To the contrary, the present invention demonstrates that abiotic tolerance can be increase by transforming a plant with a MAPK5 ortholog that is functionally similar to OsMAPK5. One skilled in the art would be aware of the various techniques available to transform a MAPK5 ortholog into a prokaryotic or eukaryotic host cell.

The Examiner further contends that there are insufficient relevant identifying characteristics to allow one skilled in the art to predictably determine allelic functional variants, orthologs, parlogs etc. of other sequences, or even other MAPK5 sequences, from another plant species or an organism would produce the desired phenotype when over-expressed in a transgenic plant. Applicant has amended Claims 27, 31, 35 and 42 to the family of monocots which corresponds to OsMAPK, the *Graminaceae* family. In particular, a MAPK5 ortholog isolated from the Grass family such as

wheat, barley rice and maize can be rapidly analyzed for increased tolerance to drought, salt and cold temperatures through the current invention without undue experimentation. Specifically, undue experimentation is not merely quantitative, since a considerable amount of experimentation is permissible. Rather, the present invention provides guidance for exploiting routine experimentation using the characteristics of OsMAPK5 to isolate a MAPK5 ortholog that is functionally similar to OsMAPK5 and enhances tolerance to abiotic stress thereby enhancing tolerance in a transformed plant.

Accordingly, Applicant submits that the present invention is a novel method for enhancing tolerance to abiotic stress in a plant by transforming a plant with a MAPK5 nucleic acid sequence in the plant wherein a MAPK5 protein functionally similar to OsMAPK5 is expressed in the plant, treating a plant with an abiotic stress; isolating the MAPK5 protein from the plant detecting the MAPK5 activity and evaluating the increase or decrease in MAPK5 activity in the transformed plant whereby the increase in MAPK5 activity indicates the increase in tolerance to abiotic stress in the transformed plant compared to the wild-type plant

3. The Claimed Invention is Not Anticipated by Wen et al.

Claims 1-10 are rejected under 35 U.S.C. § 102(a), as being anticipated by Wen et al. (Plant Physiol., 129:1880-1891, 2002). The Examiner contends that Wen et al teaches a nucleotide sequence that is identical to SEQ. ID. NO: 1 encoding a polypeptide identical to SEQ. ID. NO: 2 in the present invention. According to the Examiner, Wen et al anticipated the present invention. The rejection should be withdrawn for reasons detailed below.

Anticipation requires that all of the elements and limitations of a claim are found within a single prior art reference. There must be no difference between the

claimed invention and the reference disclosure as viewed by a person of ordinary skilled in the field of the invention. *Scripps Clinic & Research Foundation v. Genetech, Inc.*, 927 F.2d. 1565, 1576 (Fed. Cir. 1991).

Wen et al investigated the effect of low temperature above 12 °C on mitogen-activated protein signaling components, OsMEK1 and OsMAP1. Wen et al utilized northern blot analysis to detect induction of OSMEK1 and OsMAP1 transcripts. Specifically, Wen et al demonstrated that OsMEK1 and OsMAP1 transcripts were induced in rice anthers by 12 °C treatments. However, Wen et al noted that no induction of OsMEK1 and OsMAP1 transcripts were observed when seedlings were exposed to 4 °C or treated with salt.

In response, Applicant has deleted Claims 1-5 to SEQ. ID. NO: 1 and 2. Applicant has amended Claims 6-8 and added new Claims 51-55 to recite an expression vector and genetically engineered host cell comprising the nucleotide sequence of SEQ. ID. NO: 1 operatively associated with a regulatory nucleotide sequence containing transcriptional and translational regulatory information that controls expression of the nucleotide sequence in a host cell. Accordingly, Wen et al did not express OsMEK1 or OsMAP1 in a transgenic plant or any host cell. Moreover, Wen et al did not demonstrate any expression of OsMEK1 and OsMAP1. Applicant submits that since Wen et al does not disclose an expression vector or a genetically engineered host cell comprising MAPK5 that is operatively associated with a regulatory nucleotide sequence containing transcriptional and translational regulatory information that controls expression of the nucleotide sequence in a host cell, Wen et al cannot anticipate the claimed invention.

In view of the foregoing, Applicant submits that the Examiner's rejection of Claims 6-10 under 35 U.S.C. § 102 have been overcome and therefore respectfully request that the rejection be withdrawn.

4. The Claimed Invention is Not Obvious Under 35 U.S.C. § 103

Claims 1-10, 26-28, 31-32, 35, 36, 38 and 42 are rejected under 35 U.S.C. § 103, as obvious in light of cited references. Specifically, Claims 1-6, 8, 10-15 and 17 are rejected as being unpatentable over Wen et al. in view of Valvekens et al (1988 PNAS 85:5536-5549). Applicant respectfully submits that these rejections should be withdrawn for the reasons detailed.

A finding of obviousness under 35 U.S.C. § 103 requires a determination of (1) the scope and content of the prior art, (2) the level of ordinary skill in the art, (3) the difference between the claimed subject matter and the prior art, and (4) whether the differences are such that the subject matter as a whole has been obvious to one of ordinary skill in the art the time the invention was made. *Graham v. Deere*, 383 U.S. 1 (1996). The relevant inquiry is therefore (1) whether the prior art suggests the invention and (2) whether the prior art provides one of ordinary skill in the art with a reasonable expectation of success. *In re O'Farrell*, 853 F.2d 894, 903 (Fed. Cir. 1988). Both the suggestion and the reasonable expectation of success must be found in the prior art. *In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991).

Applicant submits that Claims 1-5 have been deleted thus making the rejection moot with respect these claims.

Wen et al discloses that OsMEk1 and OsMAP1 transcripts were induced in rice anthers by 12 °C treatments. However, Wen et al does not disclose any correlation of the mRNA levels to protein activity or protein levels by OsMEk1 or

OsMAP1 induction. Rather, Wen et al discloses that the mRNA levels of OsMEK1 and OsMAP1 were induced when seedlings were exposed to 12 °C but no induction when exposed to 4 °C or salt.

Valvekens et al merely provides a method for transforming *Arabidopsis* roots using a shoot rejuvenation method.

Applicant submits that there is no suggestion of the present invention in any of the references alone or in combination.

At the outset, Applicant submits that there is no mention or suggestion of any functional analysis or regulatory correlation of MAPK5 with abiotic stress. The method of the claimed invention provides for the first that an abscisic acid protein kinase is capable of inversely modulating disease resistance and abiotic stress tolerance. Specifically, over-expression of OsMAPK5 resulted in enhanced plant tolerance to drought, salt and cold stresses. The present invention provides methods for evaluating tolerance to abiotic stress in plants. Applicant respectfully emphasizes that there is no recognition or suggestion in any of the references of the invention which takes advantage of the fact that MAPK5 is induced by low temperatures and salinity.

In particular, Applicant points out that the cited references demonstrated that OsMEK1 and OsMAP1 did not play a role in abiotic stress due to low temperature or salinity. In contrast, for the first time, the present invention provides that MAPK5 plays a role in disease resistance and abiotic stress tolerance. None of the references, even in combination, suggest or show an appreciation that over-expression of MAPK5 resulted in enhanced plant tolerance to drought, salt and cold stresses. Thus,

Applicant respectfully submits that the claimed invention is not obvious in view of the cited references.

The Examiner contends that it would be obvious for one skilled in the art at the time the invention was made to express the nucleic acid sequence encoding polypeptide as taught by Wen et al in plants using any appropriate plant transformation method including the method of transforming a plant cell and regenerating a transgenic plant as taught by Valvekens et al. First, there is no suggestion in the cited references of expression of MAPK5 in a transgenic plant transformed by a nucleotide sequence that encodes a polypeptide consisting of the amino acid sequence of a MAPK5 ortholog wherein the over-expression of the MAPK5 ortholog in the plant results in increased tolerance to abiotic stress compared to a wild-type plant. Second, there is no motivation to do so as no benefit could be obtained for the purpose of the experiments described in the references. Specifically, as noted by the Examiner, Wen et al does not teach a transformed plant cell or plant or a method of producing a transformed plant cell or plant. Moreover, Wen does not teach that expression of MAPK5 under cold conditions would enhance abiotic tolerance in plants. Applicant respectfully submits that the rejection of the instant claims under § 103 would indicate the improper use of hindsight gained from Applicant's own specification. Hindsight should be avoided in applying the nonobviousness requirement. *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561, 1 U.S.P.Q.2d 1593 (Fed. Cir. 1987), *cert. denied*, 481 U.S. 1052 (1987). "One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention." *In re Fine*, 837 F.2d 1071, 1075, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988).

Without the benefit of hindsight, the teachings of the references cited by the Examiner, alone or in combination could not possibly render obvious the claimed invention. The claimed methods could not been foreseen by a person of ordinary skill in the art, since there is no suggestion of the disclosed methods in the art and their utility for evaluating the increase or decrease in MAPK5 activity in a transformed plant whereby the increase in MAPK5 activity indicates the increase in tolerance to abiotic stress in the transformed plant compared to the wild-type plant.. A finding of obviousness could only be arrived through a prohibited procedure in which "the claims were used as a frame, and individual naked parts of separate prior art references were employed as a mosaic to recreate a facsimile of the claimed invention." *W.L. Gore & Assoc. Inc v. Garlock, Inc.*, 721 F.2d 1540, 15522, 220 U.S.P.Q. 303, 312 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984).

In view of the foregoing, Applicant submits that the rejection is improper and should be withdrawn.

CONCLUSION

For all the reasons above, Applicant respectfully submits that all of the rejections based on 35 U.S.C. §112, §102 and §103 are in error or have been avoided and should be withdrawn. Applicant further submits that the present Claims 6-10, 26-28, 31, 32, 35, 36, 38, 42, 44 and new claims 51-55 are in form for allowance and respectfully request early action to that end.

Respectfully submitted,

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